ANALELE UNIVERSITATII DIN ORADEA Fascicula Ecotoxicologie,Zootehnie si Tehnologii de Industrie Alimentara

THE PROGRAMMING OF WEIGHING AND DOSING INSTALATIONS WITH PLC'S

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Abstract
The need of high performances automations installations is required much more industrial purposes; the modern approach to designing and realizing complex automation include: distributed intelligence (the division of the technological process within disjunctive components, each controlled by a compact processor); simple connections (using bus microcontrollers for connections with ARCNET, RCOM, MODBUS or Ethernet communications buses) and clear structuring design.
The paper presents the principles of distributed and decentralized architecture used in complex control systems, an exemplification for an automated dosing system, including the programming of parameters and the design of a support software.

Key words: PLC[1], PC, Master-Slave, Programming, Distributed, Decentralized.

INTRODUCTION

In complex automatizations and robotics the global tendencies are decentralization and distribution, which confer a series of capabilities and facilities to the producers of installations, and users as well.
Thus we can enumerate the possibility of interconnections of many centralized automated systems, the design of redundant structures in the goal of ensuring the safety of exploitations as the possibility to achieve hierarchical structures with programmable automata end PC's.
In any leading system, the decentralized and distributed structures with programmable automata may be considered an intelligent interface between the process and central leading system, having an insular character, in witch are concentrated the execution items as well the self communications network [Horling et al., 2006; Vladareanu et al., 2003].

MATERIAL AND METHODS

Structure of automatic systems

[1] Programmable Logic Controller

In the distributed architecture any technological process can be modeled like a multitude of processes witch are concentrated by an area around the execution items; every such process receives commands from, and sends data to, the central unit of Command and Control System of technological process [Chien et al., 2007].
Thus, the system Central Unit, via the serial communications processors has access to the central units of distributed processes, which are placed in the near neighborhood of execution items, in the areas made from the strength panel with electric action [Vladareanu et al., 2003].
In Figure 1 we can observe a structure made by m distributed stations, with every station representing a process and being comprised of a central unit, which acts as MASTER for the local network and 31 local stations with input/output modules or specialized modules, which acts as SLAVE. The m distributed stations may be interconnected through an ARCNET bus for the data and commands exchange. The ARCNET bus allows the designer to define the MASTER station and the communication priorities of the network [Vladareanu et al., 2005; Kariwala et al., 2007].

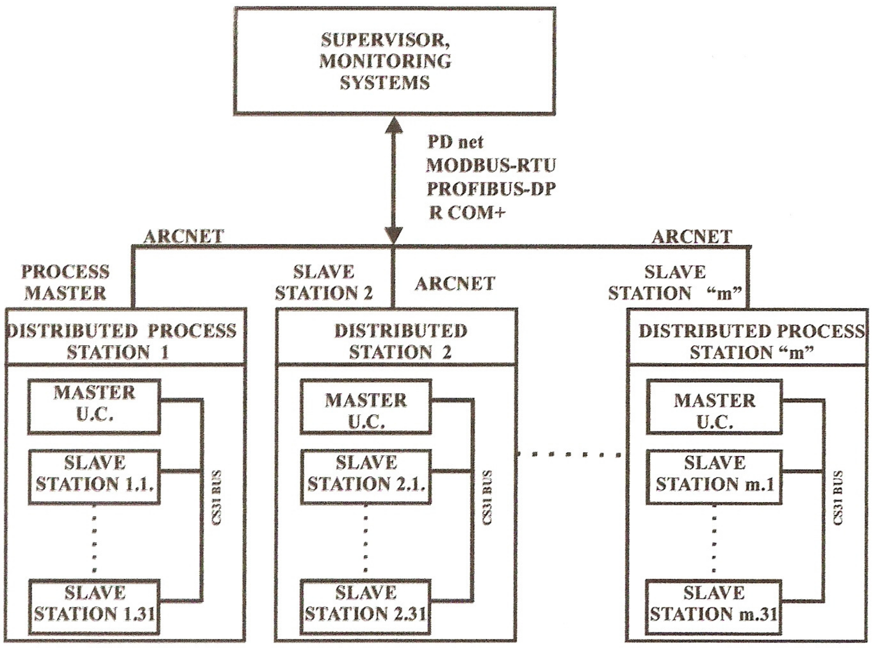


Fig. 1. Complex programmable automate structure connected in a communication network

This structure may be connected through transmission networks like RCOM+, PD-net, MODBUS-RTU, PROFIBUS-PD at a superior hierarchical level for supervision in case of monitored systems.

Automatic Dosing System

Hereinafter we present an Automatic Dosing System which exemplifies the above concepts [Vladareanu et al., 2009]. It is compose by 3 Blocks:

A. The Data Acquisition and Automation Block (D.A.A.B.)

This Block has the following role:

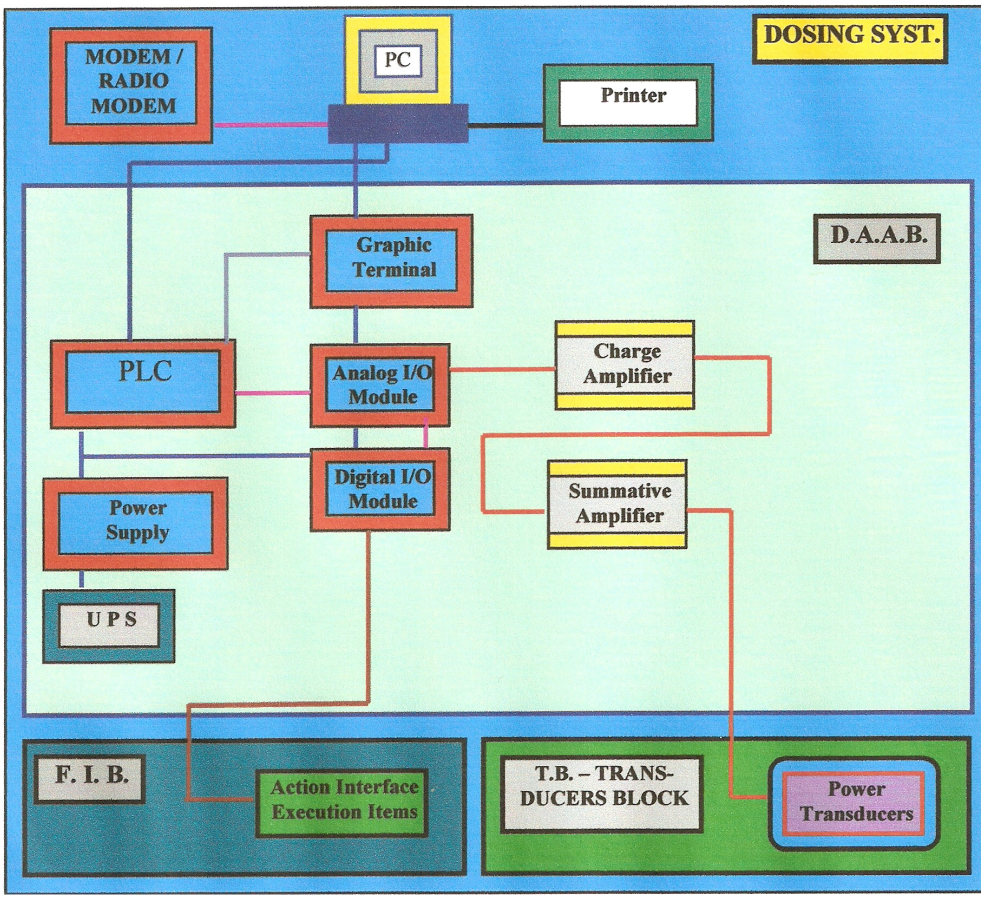


Fig. 2. The Automatic dosing system

- acquisition of transducers signals
- conversions of signals from analog to binary [Popescu et al., 2006]
- processing this information according to the software application inscribed in UC
- scaling of transducer signals
- communication with The Graphic terminal – inscription with a help of a special program of communication and display of data

-communication between PLS and PC with a help of a program resident in PC

- generation of commands for the action interface.

B. The Transducers Block (T.B.)

This Block is compose from 3 or 4 load cells which nominal values is function of the maximum of total weight for dosing. The load cells are equipped with mechanic assembling kits which ensure protection at overthrow and gliding. They achieve the compensation with temperature too. The signals from these load cells are transmitted at a summative-amplifier block which it deliver to the amplifier of electrical charge. This achieve the amplification of signal and the conversion to 16 digits.

C. The Force Interaction Block (F.I.B.)

It is a mechanic system for fastening and pre-tensioning. This block ensures the commands in voltage and/or current for the execution elements. It is composed from:

- programming automata (AC500)
- analog I/O module (AI523)
- digital I/O module (DC523)
- graphic terminal (CP513)
- power supply (CP24/5A) with UPS
- modem and PC with printer.

The Programming the Automatic Dosing System

The System is conceived to memorize the formulas which have products for dosing or weighing. Each formula is composed from 16 products P1-P16. The parameters that need to be programmed are shown in Table 1.

Table 1

Parameters

	Identifier	**Command**
Formula number	Fxxx	C100
Inferior limit	LI	C101
Superior limit	LS	C102
Overtaking - pre-alarm limit	LD	C103
Temporizer end discharge after empty bascule detection	TSG	C104
Temporizer for printing after dosing each product	TIMPDP	C105
Temporizer for printing to the end of discharge	TIMPSFG	C106
Temporizer concatenation to discharge at the end of dosing	TINSFG	C107
Temporizer concatenation to cram after the end of dosing	TINUSFD	C108
Programmed cycles number	NRCIC	C109
Concatenation with Formula Fxx	Ifxx	C110
Temporizations betweens discharges (fractioned discharges)	TGF	C111
Measures units selection	UM	C112
Weighing tara – programmable	TC	C113

For the purpose above, the system allows the programming of the formulas, one by one, after the model presented in Table 2 and 3.

Table 2

List of parameters values for a formula and for the first 8 products

Fxx x	**Identif ier**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**
C100	CD	C210	C220	C230	C240	C250	C260	C270	C280
	CDvm1	C211	C221	C231	C241	C251	C261	C271	C281
	CDvm2	C212	C222	C232	C242	C252	C262	C272	C282
	Czb	C213	C223	C233	C243	C253	C263	C273	C283
	TIP	C214	C224	C234	C244	C254	C264	C274	C284
	Vid	C215	C225	C235	C245	C255	C265	C275	C885

Table 3

List of parameters values for a formula and for the last 8 products

Fxx x	**Identif ier**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**
C100	CD	C210	C220	C230	C240	C250	C260	C270	C280
	CDvm1	C211	C221	C231	C241	C251	C261	C271	C281
	CDvm2	C212	C222	C232	C242	C252	C262	C272	C282
	Czb	C213	C223	C233	C243	C253	C263	C273	C283
	TIP	C214	C224	C234	C244	C254	C264	C274	C284
	Vid	C215	C225	C235	C245	C255	C265	C275	C885

where:

CD - Total Quantity programmed to dosing
CDvm1 - Quantity dosed on slow speed nr.1
CDvm2 - Quantity dosed on slow speed nr.2
Czb - Material Quantity existing in flight after the stop command of dosing
TIP - Temporizer concatenation for each product
Vid - Fractioned discharge or total.

RESULTS AND DISCUSSION

Structure of the application

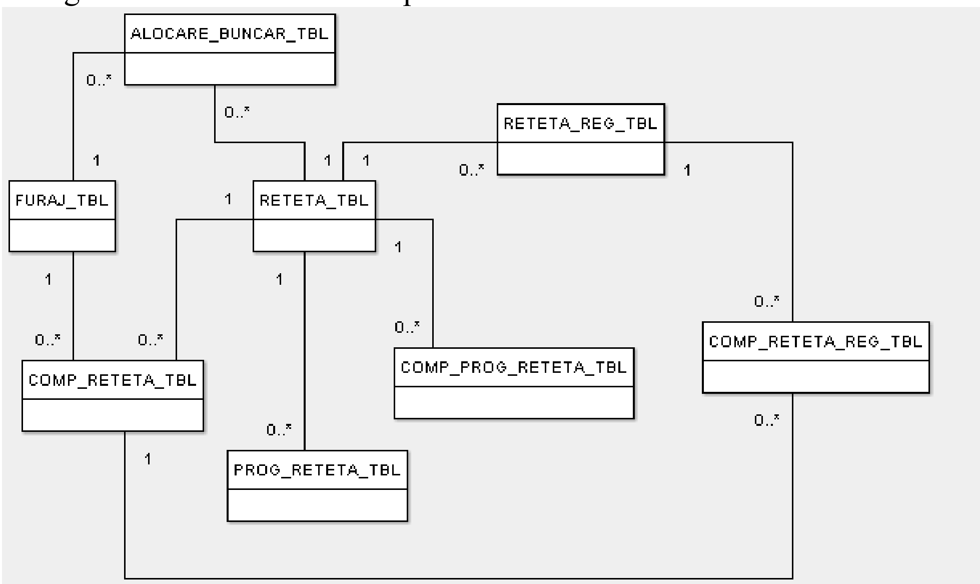
An application has been conceived which records and stores the process of dosing in a database. It was designed in a three-tier system, with following levels [Vogelsang et al., 2003; Velea et al., 1999]:

- Data level: is represented by the data base management system
- Business logic level: is the component that runs the server application
- Presentation level: is represented by the user interface which has a thin-client side (the web interface) and a thick-client side (communication with the process);

Following technologies were used:

- data level: MySql 5.0 Data Base Management System
- business logic level: Apache Tomcat 6.0 Server
- presentation level: Java Development Kit (JDK) 1.6.0 & Internet Explorer

In Figure 3 the data model is represented:



and for example in Table 4 the description of table FURAJ_TBL, which contains the information about the availability of the P1-P16 components for the Formulas, is presented.

Table 4

FURAJ_TBL

Column Name	Type	Description
ID	int	Unique identifier of the record, primary key
NUME	varchar(100)	Name of the product
STOC	Int	Existent stock
ACTIV	char(1)	Show if the record is active

CONCLUSIONS

Obtaining performance in complex automatizations of installations will be more effective when:

• the design, the conception of the programs and the utilization are friendly; the changes of information between automatic systems and users of any level (designers, programmers, operators or break-down mechanics) improve the results;

• the level of modularization and structuring is high; thus the structured systems allow the designers and engineers to work independently with a good consequence on total efficiency.

REFERENCES

1. Chien S.I., Luo J., 2007, Development of a New Virtual Reality System, Control and Intelligent Systems, Issue 4, volume 23/2007, pg. 1846-1851, ISSN: 1480-1752
2. Horling, B., Lesser V., Vincent R., Wagner T., 2006, The Soft Real-Time Agent Control Architecture, Autonomous Agents and Multi-Agent Systems, Vol: 12, Issue 1, ISSN:1387-2532, pp. 35 – 91, Springer Science
3. Kariwala V., Fraser Forbes J., Skogestad S., 2007, μ-Interaction measure for unstable systems, International Journal of Automation and Control (IJAAC), Volume 1 - Issue 4, pp. 295 – 313, ISSN (Online): 1740-7524 - ISSN (Print): 1740-7516
4. Popescu D., ş.a., 2006, Automatică Industrială, Editura Agir, Bucureşti
5. Velea L.M., Munteanu M.S., Vladareanu L., 1999, Theoretical Studies Regarding Improvement of Hierarchical Structures Based on AC31 ABB PLC and Implementations in Top Technologies from Various Fields of Economy, Ed. Mediamira, ACTA Tehnica Napocensis, vol.40, no.1, ISSN: 1221-6542, pp. 49-56
6. Vogelsang G., Vladareanu L., Velea L.M., 2003, Hierarchical Structures Based on PLC-with Radio-Modem Monitoring of Distributed Systems, Proceeding of The Annual Symposium of the Institute of Solid Mechanics, SISOM 2003, Ed. Academiei, ISBN 973-27-1006-3, pp. 211-220
7. Vladareanu L., Velea L.M., 2003, The Complex Automation Bases through Programmable Locical Controllers PLCs. Ed. MEDIAMIRA , Cluj Napoca, ISBN 973-9357-07-5, pp. 250
8. Vladareanu L., 2005, Controlul in timp real cu automate programabile in mecanica solidului. Studii si cercetari aplicative, Ed. BREN, ISBN 973-648-432-7, pp.207
9. Vladareanu L., Tont G., Munteanu R. A., Zachei Podea, Popovici D., 2009, Modular Structures in the Distributed and Decentralized Architecture, Proceedings of The 2009 International Conference on Parallel and Distributed Processing Techniques and Applications PDPTA '09, WorldComp'09, July 13-16, 2009, Las Vegas, Nevada, USA, Volume I, p. 42-47
10. Vladareanu L., 2005, Controlul in timp real cu automate programabile in mecanica solidului. Aplicatii", Ed. BREN, ISBN 973-648-433-5, pp.127, 2005